



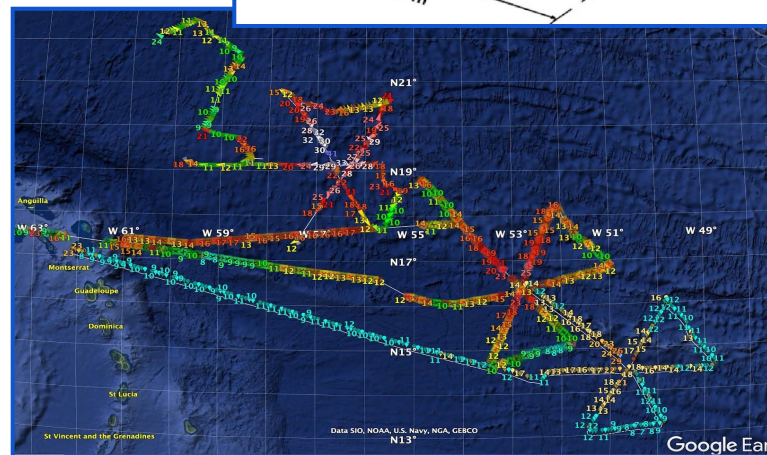
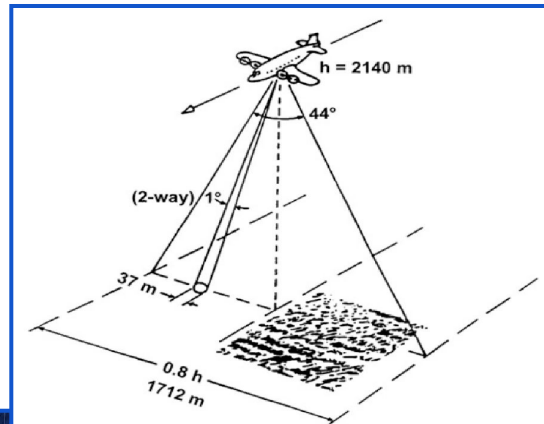
# Wide Swath Radar Altimeter for Tropical Cyclone Observations and Forecasting: Transitioning to Operations

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NOAA WP-3 Orion and observed swath observed (upper) & wave height (in ft) data from 3 reconnaissance flights for Hurricane Sam, Sept 28-29, 2021 (lower)



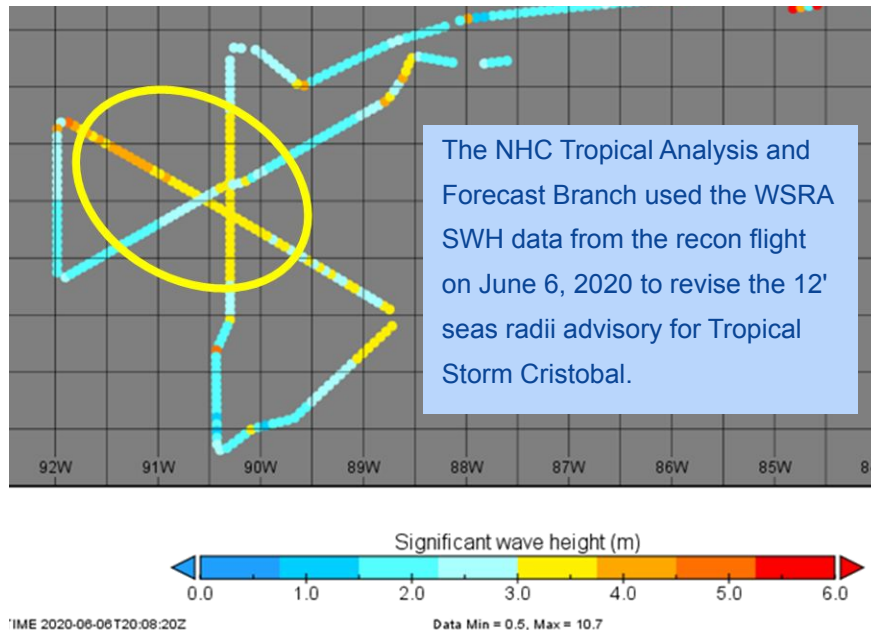
# Overview



WSRA is a major improvement in wave observations because it routinely documents the rapid spatial variation of the sea surface within the evolving hurricane.



- Provides information on wave conditions throughout the hurricane
- Research background – long history of R&D, funded by SBIR, JHT, JTTI
- How it meets needs:
  - Current NHC
  - Future EMC assimilation
- Transition plan – prototype operating for 10 years



# WSRA Meets Needs of Operational Forecasters

Meets NOAA 2021 Observational User Requirements Documents (OURD) for the TC Mission Service Area, being submitted to IHOP

- Significant wave height: w/in 0.25m,
- Wave direction: w/in 10°, wave period: w/in 1s



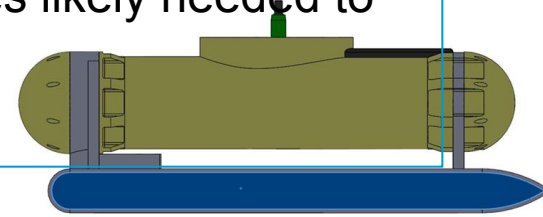
Provides continuous near-real-time reporting via satellite of:

- *Full 2-D wave spectra*, analyzed to give wave height & direction for primary & secondary wave modes.
- *Sea surface mean square slope*, additional information about the high-frequency wave spectrum associated with wind drag, a factor in hurricane intensification or weakening.
- *Rain rate* computed from signal attenuation – more accurate than either the SFMR or WSR-88-D, & better statistical samples than onboard in situ sensors or ground-based rain gauges. Synergies with SFMR-derived rain rates.
- *Storm surge* in coastal waters. It can produce about 100 samples of storm surge between pairs of shore-based tide gauges.



# Transitioning WSRA instrument to operations

- Formal plan within NOAA, umbrella and two volumes with specifics
- PSL has coordinated with all the partner research & operational offices: AOML, NHC, EMC, AOC
  - Future partners may include NWS Ocean Prediction Center (OPC) and National Ocean Service coastal prediction
- **Part 1** is **acquisition from a contractor & integration** of the NOAA WSRA onto the NOAA P-3 and includes:
  - Design for wingpod mounting, airworthiness assessment
  - Operational data transmission - only minimal updates likely needed to current transmission mode
  - Data formatted for transmission to the GTS
- Ongoing O&M and management

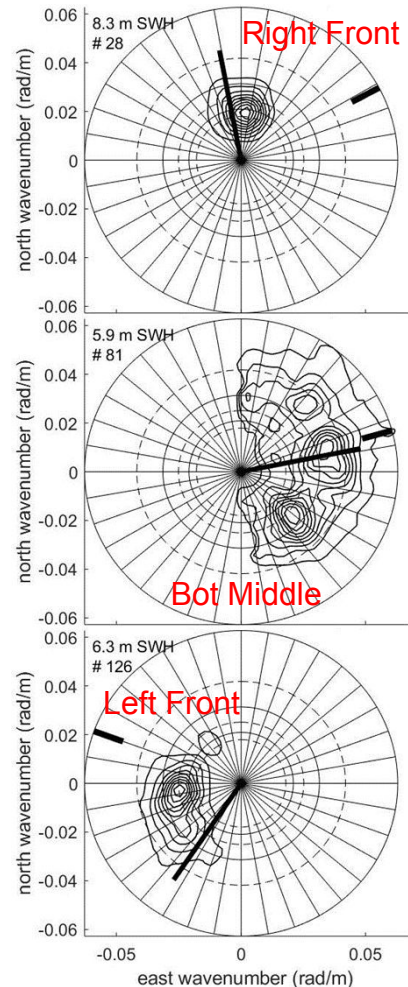


Wing pod concept



# WSRA Data Fusion & Applications

- **Part 2** is R&D needed to enhance the value and use of the **WSRA data** for TC observations, data assimilation, and existing coupled TC forecast modeling system & WaveWatch III
- Evaluate performance of operational WWIII model physics
  - Collaboration among PSL, AOML and NCEP
  - Includes wave height, wave steepness, wave phase velocity, 2-D wave spectra
- Implementation of operational data transmission to GTS in real time and to NCEP
- Assimilation of WSRA wave data into experimental coupled models at AOML, and into operational coupled models at NHC and EMC to improve skill and accuracy of forecasts.

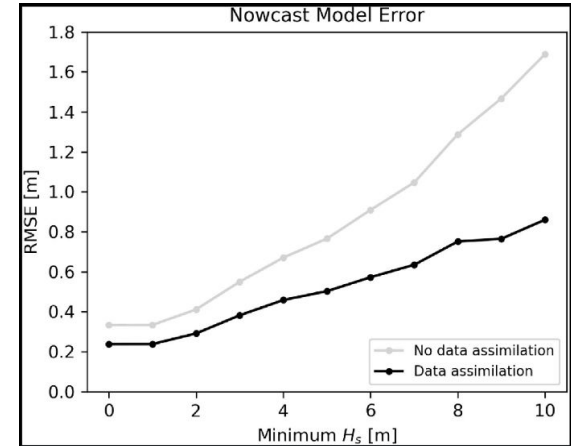


# WSRA Transition Plan: Research to Operations

NOAA R2O Transition Plan developed & in signature phase after informal review by all parties  
PSL, AOML, AOC, EMC, JHT

Signed transition plan expected to improve potential for securing funding

Anticipated operational capability of instrument and use of data expected to  
benefit hurricane prediction and potentially benefit storm surge and marine weather



Model RMSE fw/without data assimilation as a function of minimum observed significant wave height. The model w/ data assimilation always outperformed the model w/o data assimilation. Predictions in sea states with large significant wave heights showed even larger improvements (Smit et al. 2021)